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perfect sources of information; and that I had no wish to assert the claims of Messrs. Locke and Mitchell further than as they seemed to be implied in those documents, nor to express any opinion on the claims of others, either to the first idea or to the subsequent steps of the invention."

Description of the Apparatus for observing Transits, by means of a Galvanic Current, now used at the Observatory of Cambridge, U.S. By Mr. G. P. Bond.*

The apparatus exhibited to the Society, is the same which has been for some time past in use at the Harvard Observatory, U.S., and is the property of the United States Coast Survey. It consists of an electric break-circuit clock, a galvanic battery of a single Grove's cup, and the spring governor, by which a uniform motion is given to the cylinder carrying the paper.

The electric clock is of the form proposed by Mr. Bond. Though different in its object and construction, the effect produced is the same with that of the clock proposed by Professor Wheatstone, namely, the interruption of the galvanic circuit at intervals of a second. The pallets and the escapement-wheel are insulated, both from the pendulum and from the other wheels. When the battery is in connexion, the circuit is broken by the pallet leaving the tooth of the wheel, and is restored at the instant of the beat of the clock, which is in fact the sound produced by the completion of the contact restoring the circuit: the passage of the current being through the pallet and the escapement-wheel alone. With the exception of the connecting wires, and the insulation of some parts, the clock is like those in common use for astronomical purposes.

Two wires pass from the clock, one direct to the battery, and the other, through the break-circuit-key used by the observer, and through the recording magnet, back to the battery. The length of wire is of course immaterial.

The magnet, with a slight difference in the form of the armature, is the same with those used on Morse's telegraph lines in the United States. The armature carries a glass pen, supplied with ink from a small reservoir. Under this pen the paper revolves on which the records are made. The breaking of the circuit by the clock, every second, is marked by an offset made by the pen, and the breaking of the circuit by the observer, is similarly recorded between the second marks of the clock. The paper is wound upon a cylinder, as suggested by Mr. Saxton of Washington. Unless a motion perfectly uniform is given to the cylinder, the second marks at the end of an hour, instead of being arranged in regular straight lines upon the paper, will change their relative positions, and the record become so confused as to make it a most serious undertaking to read off the observations after they have been taken.

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* This is the substance of a lecture delivered by Mr. Bond, in which the whole *modus operandi* was clearly shown.

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To give a uniform motion to this cylinder has been the chief obstacle in the way of the application of electro-magnetism to practical astronomy, so that it should be of general utility; for although very rude contrivances will illustrate the process, and even afford accurate results, the time required to interpret the record may be greater than that required to make the observations throughout by the old method, and the liability to errors in the minutes and seconds is increased. A saving in the quantity of recording surface was also requisite.

The apparatus invented at Cambridge for this object is called the spring governor. The train of wheels which communicates the motive power to the cylinder connects with a small fly-wheel. This fly is for supplying momentum, and holds no part in the regulation. Beyond this fly, reckoning from the cylinder, is a half-seconds pendulum, with a dead-beat escapement. The connexion between the escapement-wheel and the fly is through a short spring. The elasticity of this spring allows the motion of the escapement-wheel to be completely arrested at each vibration of the pendulum, while the momentum of the fly, acting for a small fraction of a second only on the spring, keeps up the motion of the cylinder. The machinery is thus completely under the control of the pendulum. No accumulation of irregularity can take place beyond the limits of the bending and unbending of the connecting spring. After this is adjusted to its minimum, the continuous rotary motion will be performed with all the accuracy of the beats of the pendulum for any length of time. It is, in fact, a complete solution of the difficulty of producing exact uniform motion. An advantageous application of the same principle might be made to the clock-work for the equatoreal motion of telescopes.

The cylinder makes a single rotation in a minute. The second marks and the observations succeed each other in a continuous spiral. When a sheet is filled, and it is taken from the cylinder, the second marks and observations appear in parallel columns, as in a table of double entry, the minutes and seconds being the two arguments at the head and side of the sheet.

The observer, with the break-circuit-key in his hand or at his side, at the instant of the transit of a star over the wire of a telescope, touches the key with his finger. The record is made at the same instant on the paper. The operation may be repeated easily, at intervals between the successive transits, of one or two seconds each.

The experience we have now had places beyond doubt the fact that, for convenience and accuracy of individual results, this new mode of observing is in advance of the old. The number of comparisons for differences of right ascension may be increased to an extent which distinguishes it, equally with its superior accuracy, as a real improvement in the science of practical astronomy. The extension of the method to the registration of differences of declination, simultaneously with differences of right ascension, promises great facility in taking zones of small stars.

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Owing to the difficulty of obtaining precise information respecting scientific matters in America, considerable inaccuracies have crept into the *historical* part of the lecture given by the Astronomer Royal on the American method of observing by the electro-magnetic circuit (*Monthly Notices*, Dec. 1849). The preceding note from the Astronomer Royal will prevent misconception on this point. But, setting aside the claims of individuals in this matter, so far as this is an American discovery, it is only under the auspices of the Department of the Coast Survey of the United States, and with the facilities and means furnished by its present enlightened superintendent, Dr. A. D. Bache, that the application of electro-magnetism to the purposes of geodesy and of astronomy has been successfully accomplished.

Daguerreotypes of the moon were exhibited to the members present, taken by Messrs. Whipple and Jones, of Boston, from the image formed in the focus of the great equatoreal of the Harvard Observatory.

Extract of a Letter from Mr. Lassell.

"I have been very busy, and have brought to a most successful issue my efforts to support my two-foot speculum free from sensible flexure. All has gone on well and come right at once; and the speculum having been once placed in the tube, I have neither reason nor inclination to take it out again. I was pretty sanguine, yet must acknowledge the result has gone beyond my hopes. I announced the details of the plan to the British Association at Edinburgh,[*] and there is a clear and sufficient description of it in the Report just about publishing, or perhaps already out. I have scarcely varied at all in carrying it out. I have found 27 or 28 levers sufficient; and these are about as many as can be conveniently applied without interfering with the 18 discs and levers for zenithal support. Moreover, I have found cementing fulcral blocks of speculum metal upon the back with plaster of Paris quite efficient—firm enough to bear twice the requisite strain. Each lever, in a horizontal position of the tube, supports 15 lbs. of the speculum's weight; diminishing, of course, as the telescope approaches the zenith, where they are inactive. The superiority of action of the telescope since the application of this apparatus, I think none but myself who have seen it in both states can yet appreciate, and the atmosphere now alone remains my formidable and unconquerable foe, as it is indeed of all large apertures. So tenderly is the metal sustained in all positions, that no part of it can ever come into contact, with more than the pressure of a few pounds, against the tube or box in which it

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[*] *Reports of the Twentieth Meeting of the British Association*, 1850; *Notices and Abstracts*, p. 180, &c. On a method of supporting a large speculum, free from sensible flexure, by Mr. Lassell, &c.